

AD-A138 594

STABILITY CALCULATIONS FOR HRRPHHO FEASIBILITY
DEMONSTRATION(U) HENRY (J J) CO INC ARLINGTON VA
P J PIERCE 01 SEP 82 N00019-82-M-0323

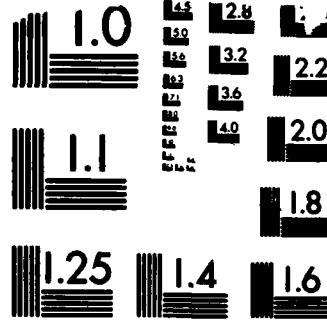
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UNCLASSIFIED

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END
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

J.J. HENRY CO. INC.

NAVAL ARCHITECTS · MARINE ENGINEERS · MANUFACTURERS

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1235 JEFFERSON DAVIS HWY.
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File 2064 00/FYM-3.0
9/9/82

AD A 138594

Commander
Naval Air Systems Command
Department of the Navy
Washington, D.C. 20361

Attention: Mr. J. J. Mulquin
NAVAIR ADPO-15

Dear Sir:

J. J. Henry Co., Inc. (JJH) has completed a review of ARAPAHOO as it would be configured for the upcoming feasibility demonstration aboard C5-S-73b (Export Leader) container ships, as requested. This review has included contact with the U.S. Coast Guard, the Maritime Administration (MARAD), the Norfolk International Terminal, and a visit to the ARAPAHOO system on site at NAEC in Lakehurst, New Jersey. The Coast Guard has indicated that they will inspect the vessel at the request of MARAD, but will not issue a Certificate of Inspection. During this inspection, the requirements of Title 46 CFR, Parts 90 through 109, will be applied. They also desire a demonstration schedule, so traffic problems in the area can be avoided.

The C5-S-73b ships will be compatible with ARAPAHOO for the feasibility demonstration. Visibility for the ship's officers from the navigation bridge will be adequate, as the entire ARAPAHOO system will be aft of the forward house. Deck area and load capacity are sufficient for the intended application, and stability is satisfactory. Metacentric height (GM) should be approximately 8.5', compared to the minimum requirement of approximately 4.0'. It is anticipated that the mean draft of the ship during the demonstration will be about 15'-2", with a trim of 9'-1" by the stern, which provides a trim angle of less than 1.0°. Additionally, loading of the ARAPAHOO aboard this class of ship in its light condition at the Norfolk International Terminal will remain unhampered by vertical clearances at any stage of the tidal cycle. The above considerations indicate that the physical properties of the ARAPAHOO/ship class combination will be acceptable for the feasibility demonstration. Seakeeping characteristics of the vessel should not be of major concern since the demonstration is going to be conducted in protected waters (the Chesapeake Bay). According to statistical meteorological data, the normal average wind speed during the month of October is on the order of 10 miles per hour. The waves associated with this wind are 1 to 2 feet high. For the size of the ship and its motion characteristics, this will not cause any significant problem. The natural period of roll was estimated at 12.0 seconds and the natural period of pitch was estimated to be on the order of 16.0 seconds. With these natural period parameters, only swells above 8 to 10 feet in height would cause significant ship's motions.

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This review has also considered supporting systems. It is advised that the plan to use two tugs for the feasibility demonstration be retained. Safety considerations dictate that both tugs remain in constant radio contact with the pilot and master on the demonstration ship's navigation bridge, and that the tug not involved in the towing operation maintain a vigilant watch on station nearby for rescue operations or emergency maneuvers. Internal communications systems and ship's radio must provide contact between the navigation bridge and the following areas, as planned: tugs, machinery spaces, anchor watch area, helicopter control station, both after and forward houses, D.C. Central, and other vessels in the area. As a minimum, the ship's radio should be operational and in compliance with Title 33 of the Code of Federal Regulations (CFR) Part 26, and Title 47 CFR, Parts 81 and 83. The proposed firefighting systems seem adequate. Review of correspondence by Cerberonics, Inc. indicates that CO₂ flooding will not be available in the machinery spaces. Particular caution must be exercised in the protection provided this area. The general alarm system should be fully operational. The fuel farm and its connections and hoses are not in compliance with Coast Guard regulations for commercial vessels, so caution must be exercised here also. The ARAPAHO system will be prone to spills of the JP-5 because no provision has been made for spill containment or periodic shut-off valves in the lines to isolate possible ruptures. It is assumed that lifesaving equipment will be provided in quantity and location as required by the Coast Guard and as detailed by Title 46 CFR, Part 94. In the area of accommodations, the Coast Guard requires that all systems be activated. This includes: ventilation, air conditioning, lighting, fresh water, sanitary water, the general alarm system and firefighting.

Some areas of potential risk to the success of the ARAPAHO feasibility demonstration are listed below. These are not considered to have a major impact on the tests to be conducted in the Chesapeake Bay, but are presented here to complete the review.

- a. Safety Nets - should be used around the edge of the landing area during the feasibility demonstration.
- b. Escape Routes - NAEC personnel have expressed concern that some modules have only one access.
- c. Electrical Power Distribution Center - Moisture present in this module may be the cause of short circuits which have occurred. The solution may be to install dehumidification equipment.
- d. Fuel Handling - no provision has been made for spill containment or isolation of leaking sections of rubber hose, as mentioned above.
- e. Lashing System - the lashing arrangement was not entirely in place for JJH review. Therefore we cannot comment on the adequacy of the lashing system.



Att. 232
H. J. 232

A. J. 232

(cont'd.)

It is concluded that

In conclusion, as far as naval architectural aspects are concerned, the ship "Export Leader" is matched to the purpose intended and the demonstration should be technically sound and effective.

Very truly yours,

J. J. HENRY CO., INC.


G. R. Jones

G. R. Jones
Manager

FYM/kc

Stability Calculations for
ARAPAHOE Feasibility Demonstration

Prepared: P. J. Rease
Checked: M. Y. Michael

Prepared by:

J.J. Henry Co., Inc.
Suite 1305
1235 Jefferson Davis Highway
Arlington, VA 22202

September 1, 1982

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CONDITION OF VESSEL CARGO % CONSUMABLES % BALLAST % NO DATE BY PAGE JOB NO

ARAPAHO (SEAWITCH CONFIGURATION)

- No. Accommodation modules
- Port Side Fuel Farm

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REF LINE FOR V.C.G.

REF LINE FOR L.C.G.

COMPARTMENT	CU FT TON	WEIGHT TONS	VCG ABV. BL FT	MOMENT ABV. BL FT TONS	LCG ABT. F.P. FT	MOMENT ABT. F.P. FT TONS	VERT OF FT TO
ARAPAHO Test Modules	722.7	34.17	59,946.24	275.09	253,322.53	12	
Fuel, Water	60.0	39.09	2,344.8	462.50	277.50.0	17	
Personal Effects	6.0	64.0	24.0	24.0	1,770.0		
DEADWEIGHT	488.7	63.30	62,675.14	23.23	293.42.1	2	
LIGHT SHIP	10,361.0	25.42	267,792.12	513.21	526,108.4		
DISPLACEMENT	11,352.7	29.10	330,577.26	512.37	521,410.0		

TRIM

DRAFT AT LCF	= 15.16 FT
MOMENT TO ALTER TRIM 1°	= 1792 FT-TS
LCB AFT OF FP	= 293.73 FT
LCG AFT OF FP	= 310.89 FT
TRIMMING LEVER	= 17.16 FT
TRIM	= 9.0 FT
LCF AFT OF FP	= 17.10 FT
DRAFT AT FP	= 10.52' AP = 17.59'

DRAFTS AT DRAFT MARKS
FWD = 10.7 1/4" AFT = 18.9 1/8"

midship MEAN = 15.1 1/2"

STABILITY

METACENTRE ABOVE BL	MR = 37.70
CENTRE OF GRAVITY ABV BL	CG = 29.10
METACENTRIC HEIGHT	MR = 8.00
ALLOWANCE FOR FREE SURFACE	= .01
MR CORRECTED	= 9.59
MR REQUIRED (MAX. WIND LOAD)	= 5.95
MOMENT TO HEEL 1°	= 1712 FT

J.J. HENRY CO. INC.

NAVAL ARCHITECTS - MARINE ENGINEERS
NEW YORK PHILADELPHIA

J. J. HENRY CO., INC.

Naval Architects and Marine Engineers

NAME OF COMPANY ARAFAH'S STABILITY & TRIM

SUBJECT - SUMMARY OF WEIGHTS & CENTERS

J. J. HENRY CO., INC.
Naval Architects and Marine Engineers

NAME OF COMPANY APPARATUS stability & trim
SUBJECT FUEL EFFF - ASSUMES TANKS FULL

J. O. No. 2064-00
SHEET NO. 3 OF 19
DATE 5-30-32
COMP. BY P.J.P. C.K'D BY

J. J. HENRY CO., INC.
Naval Architects and Marine Engineers

NAME OF COMPANY ARAPAHO STABILITY & TRIM
SUBJECT 01 Longitudinal / Adaptive

J. O. NO. 2034-C
SHEET NO. 4 OF 19
DATE 9-21-37
COMP. BY J.P. C'K'D BY

MODULE	WEIGHT IN LONG TONS	VCG	VERTICAL MOMENTS	LCG	LONGITUDINAL MOMENTS
01-OP Modules	55.01	59.9'	3,295.1	429.0'	23,599.21
01-M11 Modules	59.96		3,561.65	386.3'	22,969.4
01-KL Modules	59.79		3,581.42	339.5'	20,299.41
01-IJ Modules	54.8'		3,232.52	295.5'	16,193.40
01-CH Modules	62.64		3,752.14	249.00'	15,597.36
01-EF Modules	59.42		3,559.26	206.03'	12,245.27
01-CD Modules	58.93		3,529.91	159.11'	9,379.39
"NO" Adapters	20.0		1,198.0	407.65'	3,153.0
"LM" Adapters	20.0		1,198.0	362.90'	7,259.0
"JK" Adapters	20.0		1,198.0	517.50'	6,350.0
"HI" Adapters	20.0		1,198.0	272.25'	5,445.0
"FG" Adapters	10.0		599.0	227.54'	2,275.4
"DE" Adapters	10.0	59.9'	599.0	182.65'	1,826.5
TOTALS			30,552.0		151,591.0
	510.05	59.90		297.21	

J. J. HENRY CO., INC.

Naval Architects and Marine Engineers

NAME OF COMPANY

1/1971: Stability & trim

SUBJECT

220 JE (s.s.) No. 62 (except fuel tank)
(No Accommodations)

J. O. NO.

SHEET NO.

DATE

COMP. BY

19

MODULE	WEIGHT IN LONG TONS	VCG	VERTICAL MOMENTS	LCG	LONGITUDINAL MOMENTS
02-FG-6					
02-FG-5	41.95	65.15'	2,733.04	227.54'	9,545.3
02-FG-7					
02-DE-6					
02-DE-5	49.53	65.15'	3,226.88	132.55'	9,045.66
02-DE-7					
02-C-6					
02-C-5	23.84	65.15'	1,553.18	149.17'	3,556.21
02-C-7					
03-FG-6					
03-FG-5	50.18	73.65'	3,695.76	227.54'	11,417.96
03-FG-7					
03-DE-6					
03-DE-5	52.75	73.65'	3,335.04	132.63'	9,633.73
03-DE-7					
03-C-6					
03-C-5	22.62	75.65'	1,665.96	149.17'	3,374.23
03-C-7					
TOTALS	240.87	69.58'	16,759.96	193.35'	46,573.09

J. J. HENRY. CO., INC.
Naval Architects and Marine Engineers

NAME OF COMPANY ARAPAHOE Stability Train
SUBJECT 04 & 05 (new) Modules

J. O. NO. 2061-03
SHEET NO. 6 OF 19
DATE 3-21-22
COMP. BY MF C.K'D BY

MODULE	WEIGHT IN LONG TONS	VCG	VERTICAL MOMENTS	LCG	LONGITUDINAL MOMENTS
04-FG module	18.0	78.78'	1,413.04	227.5'	4,095.0
04-DE module	18.0	73.73'	1,419.04	182.65'	3,287.34
04-C module	9.0	75.73'	709.02	142.17'	1,342.57
05 Land module	62.65	80.44'	5,039.51	193.9'	12,147.31
TOTALS	107.65	79.75	8,584.67	193.89	30,872.71

J. J. HENRY CO., INC.

Naval Architects and Marine Engineers

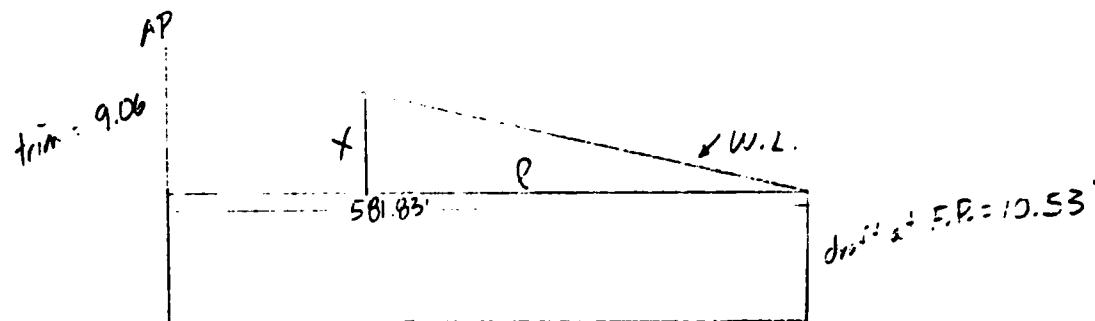
NAME OF COMPANY ARAPAHO Stability & trim

SUBJECT Draft & Trim calc's

J. O. No 2054-32
SHEET NO 1 OF 1
DATE 9-1-52
COMP. BY P.C. C.KD BY

to solve for draft at any distance "l" from F.P.

(Use similar triangles)



$$\text{desired draft} = 10.53' + x$$

$$\text{and } \frac{l}{581.83'} = \frac{x}{9.06'}, \quad x = \frac{(l)(9.06)}{581.83'}$$

$$\text{so draft at any distance "l" from F.P.} =$$

$$\boxed{\frac{(l)(9.06)}{581.83'} + 10.53'}$$

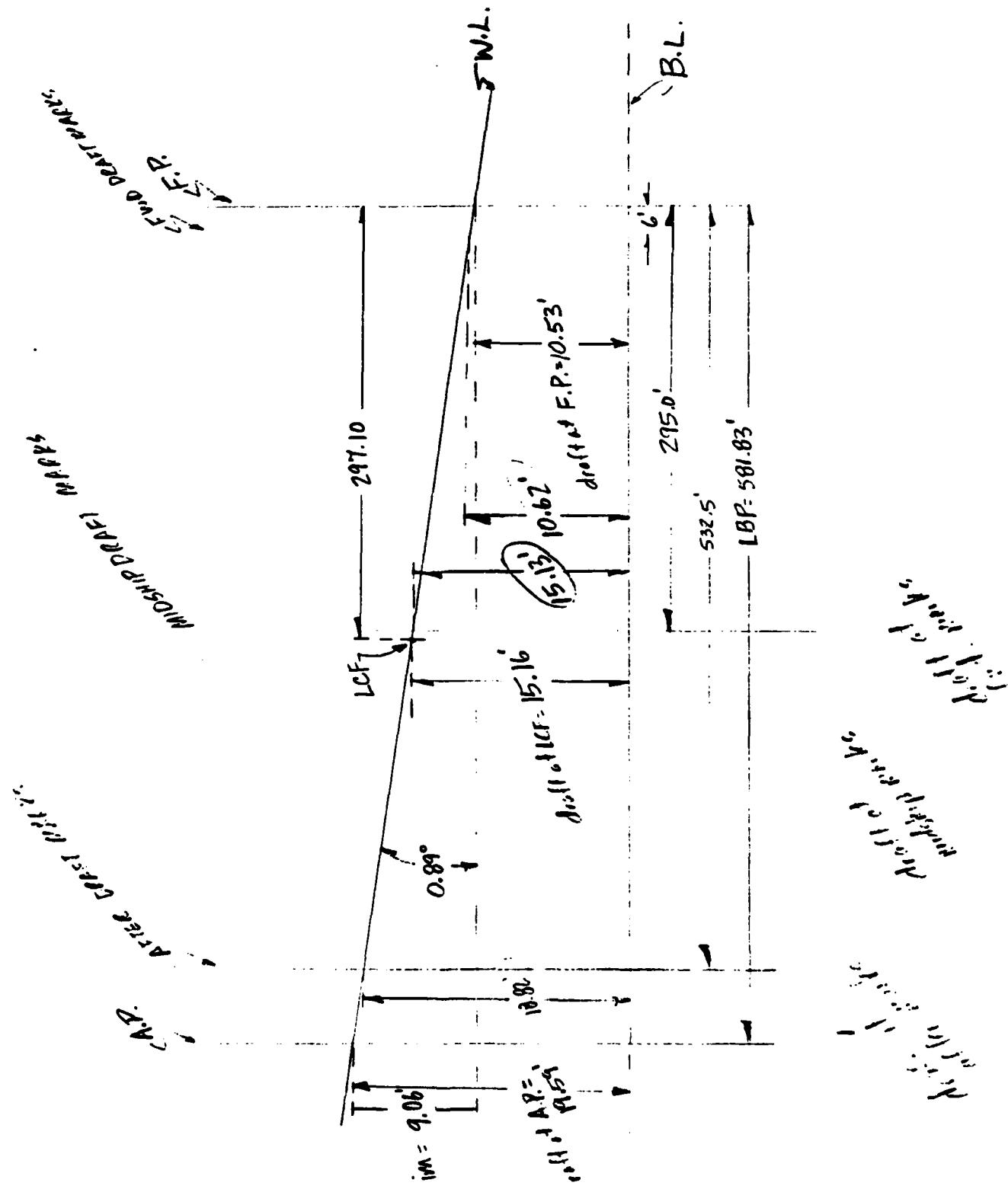
17.5' of trim

$$\text{Angle of trim} = \arctan \left(\frac{\text{trim}}{\text{LBP}} \right) = \arctan \left(\frac{9.06}{581.83'} \right) = 0.392^\circ$$

J. J. HENRY CO., INC.
Naval Architects and Marine Engineers

NAME OF COMPANY APPALOOSA STIRRUP CO.
SUBJECT Dress & Trim Colors

J. O. NO. 2034-02
SHEET NO. 8 OF 19
DATE 1-1-52
COMP. BY C.K'D BY

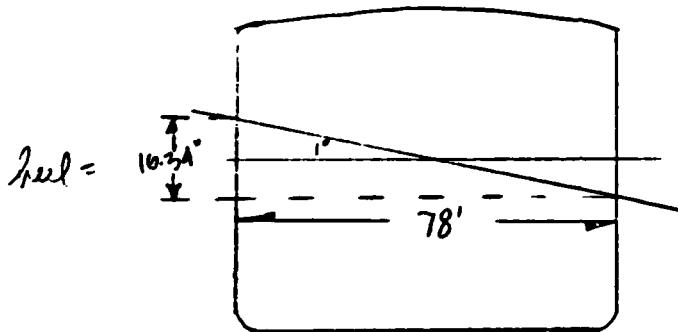


J. J. HENRY CO., INC.

Naval Architects and Marine Engineers

NAME OF COMPANY ARAPAHOE Stability & Trim
SUBJECT Stability CodesJ. O. No. 2061-00SHEET NO. 9 OF 19DATE 9-1-32COMP. BY PIP C.K'D BY.Moment to heel 1°

$$\text{moment to heel } 1^\circ = \frac{\Delta GM_T}{12 B} = \frac{(11,352.7 \text{ tons})(3.59 \text{ ft})}{(12)(78 \text{ ft})} = 104.18 \text{ ft.-tons}$$



$$\text{moment to heel } 1^\circ = (104.18 \text{ ft.-tons})(16.34^\circ) = 1,702 \text{ ft.-tons}$$

- or -

$$\text{Moment to heel } 1^\circ = (\Delta)(GM \sin 1^\circ) = (11,352.7)(3.59 \sin 1^\circ) = 1,702 \text{ ft.-tons}$$

FREE SURFACE

(assumes one fuel tank slack)

$$\text{Increase in vert. moments: } \frac{I}{S} = \frac{(20)(8)^3}{12} = 19 \text{ ft.-tons}$$

(one tank of 38,000 cu ft @ 49.167 ft)

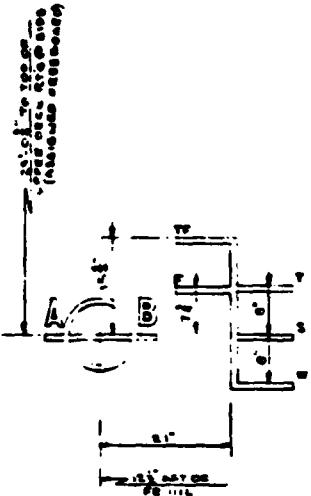
Assume center of fuel tank at 117 ft. from stbd. bow

$$\text{free surface correction} = \frac{19 + 117}{11,352.7} = 0.01 \text{ ft rise in ft}$$

2000 100 19
100 100 19
9-1 32 38

4

STEEL SHEET FEET	DISPLACEMENT WEIGHT TONS WATER + L. TONS	EM DEPTH	MOMENT TO TURN ONE INCH	TONS PER INCH IMMERSED	FEEL DRAFT FEET
50	50000				
49	49000				33
48	48000				33
47	47000				33
46	46000				33
45	45000				33
44	44000				33
43	43000				33
42	42000				33
41	41000				33
40	40000				33
39	39000				33
38	38000				33
37	37000				33
36	36000				33
35	35000				33
34	34000				33
33	33000				33
32	32000				33
31	31000				33
30	30000				33
29	29000				33
28	28000				33
27	27000				33
26	26000				33
25	25000				33
24	24000				33
23	23000				33
22	22000				33
21	21000				33
20	20000				33
19	19000				33
18	18000				33
17	17000				33
16	16000				33
15	15000				33
14	14000				33
13	13000				33
12	12000				33
11	11000				33
10	10000				33
9	9000				33
8	8000				33
7	7000				33
6	6000				33
5	5000				33
4	4000				33
3	3000				33
2	2000				33
1	1000				33
0	000				33



PLIMSOLL MARK
1 FOOT
TOTAL DISPLACEMENT (3,400-26,670) P 31.78 DEPART
EQUIV. DEADWEIGHT = 16,343 T.

A. B. B. STAMP & CO., LTD.

$$\Delta = 11,352.7 \text{ L tons}$$

TANK	FRAMES	INTER SE WGT	
		KG/MB	KG/MB
SEED TANK NO. 1	0	35.51	16.98
SEED TANK NO. 2	0	35.51	16.98
DOUBLE BOTT NO. 1	0	51.79	2.67
DOUBLE BOTT NO. 2	0	51.79	2.67
DOUBLE BOTT NO. 3	0	79.00	2.66
DOUBLE BOTT NO. 4	0	79.00	2.66
DOUBLE BOTT NO. 5	0	79.00	2.66
DOUBLE BOTT NO. 6	0	79.00	2.66
DOUBLE BOTT NO. 7	0	79.00	2.66
DOUBLE BOTT NO. 8	0	79.00	2.66
DOUBLE BOTT NO. 9	0	79.00	2.66
DOUBLE BOTT NO. 10	0	79.00	2.66
DOUBLE BOTT NO. 11	0	79.00	2.66
DOUBLE BOTT NO. 12	0	79.00	2.66
SETTLING TANK	0	194.204	24.36
SETTLING TANK	0	194.204	24.36
TOTALS		868	280.23

FRESH WATER					
TANK	FRAMES	CENTER OF GRAVITY		SALTS	
		REL. AHD 0	DEPTHS	REL. AHD 0	DEPTHS
RESERVE TANK	D 170-178	2 60	467 03	1050	0000
RESERVE TANK	D 170-178	2 66	466 89	0000	
POTABLE WATER TANK	D 160-178	30 00	462 80	0000	
POTABLE WATER TANK	D 160-178	39 00	462 80	1310	
DISTILLED WATER TANK	D 160-178	39 00	462 80	1310	
TOTALS				26 46	464 04
					3900

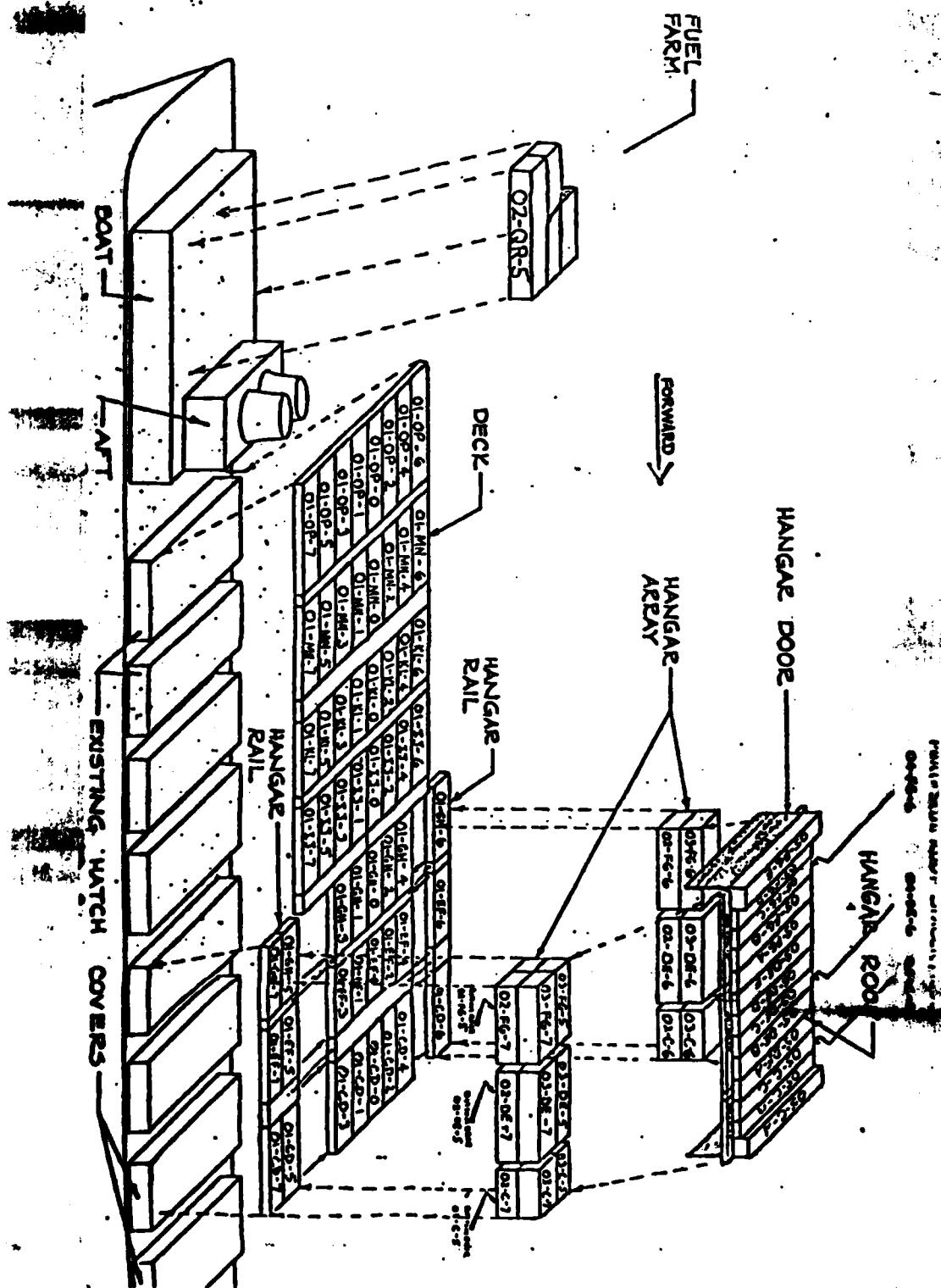
CONVERSION TABLE	
UNIT	EQUIVALENT
1 TON	2240 LB
1 BARREL	416 GALL
1 BARREL	56.16 CUB FT
1 CUBIC YARD	27 CUB FT

2054-00
Sheet 11 of 19
9-1-82 PJP

ARAPAHO FEASIBILITY DEMONSTRATION

HCST SHIP SPECIFICS

2064-00
Sheet 12 of 19
9-1-82 PJP



GROSS WEIGHT

<u>LOAD</u>	<u>DESCRIPTION</u>	<u>LONG TONS</u>	<u>LBS</u>
1	02-QR-5	9.8	20,196
2	01-OP-4, 01-OP-6	13.95	28,000
3	01-OP-1, 01-OP-0, 01-OP-2	20.43	44,946
4	01-OP-7, 01-OP-5, 01-OP-3	20.63	45,386
5	OUTFITTING VAN	T.B.D.	
6	01-MN-4, 01-MN-6	14.99	32,978
7	01-MN-0, 01-MN-2	14.78	32,516
8	01-MN-3, 01-MN-1	14.78	32,516
9	01-MN-7, 01-MN-5	14.91	32,802
10	SPECIAL EQUIPMENT	T.B.D.	
11	"NO" DECK ADAPTERS..	20	44,000
12	01-KL-4, 01-KL-6	15.12	33,264
13	01-KL-0, 01-KL-2	14.78	32,526
14	01-KL-3, 01-KL-1	14.90	32,780
15	01-KL-7, 01-KL-5	14.99	32,978
16	"LM" DECK ADAPTERS	20	44,000
17	01-IJ-2, 01-IJ-4, 01-IJ-6	20.63	45,386
18	01-IJ-3, 01-IJ-1, 01-IJ-0	20.54	45,188
19	01-IJ-7, 01-IJ-5	13.63	29,986
20	"JK" DECK ADAPTERS	20	44,000
21	01-GH-4, 01-GH-6	16.34	35,948
22	01-GH-0, 01-GH-2	13.75	30,250
23	01-GH-3, 01-GH-1	13.76	30,272
24	01-GH-7, 01-GH-5	18.4	40,480
25	"MJ" DECK ADAPTERS	20	44,000
26	01-EF-4, 01-EF-6	15.66	34,452
27	01-EF-1, 01-EF-0, 01-EF-2	20.23	44,506
28	01-EF-5, 01-EF-3	16.18	35,596
29	01-CD-7, 01-EF-7	14.69	32,318
30	01-CD-4, 01-CD-6	15.34	33,748
31	01-CD-1, 01-CD-0, 01-CD-2	20.21	44,462
32	01-CD-5, 01-CD-3	16.04	35,288
33	02-C-6, 02-C-7	15.04	33,088
34	03-C-6, 02-C-5	17.16	37,752
35	03-C-5, 03-C-7	14.26	31,372

NOTE: THIS TABLE HAS BEEN DEVELOPED ON THE INCORRECT ASSUMPTION THAT 1 LONG TON = 2200 LBS.
 FOR THE PURPOSE OF THIS CALCULATION, UJN HAS ASSUMED THAT THE VALUES FOR LONG TON'S
 ARE CORRECT, BECAUSE THEY SEEM TO COME FROM AN EARLIER STUDY.

LOAD	DESCRIPTION	GROSS WEIGHT	
		LONG TONS	LBS
36	02-DE-6	16.47	36,234
37	"FG" and "DE" DECK ADAPTERS	20	44,000
38	02-DE-7	14.69	32,234
39	03-DE-6	20.32	44,704
40	02-DE-5	18.37	40,414
41	03-DE-5	16.25	36,750
42	03-DE-7	16.18	36,618
43	02-FG-6	14.07	30,954
44	02-FG-7	12.57	27,654
45	03-FG-6	18.37	40,414
46	02-FG-5	15.31	33,682
47	03-FG-5	14.6	32,120
48	03-FG-7	17.21	37,862
49	04-C-6, 04-C-5	9	19,980
50	04-DE-6, 04-DE-5	18	39,600
51	04-FG-6, 04-FG-5	18	39,600
52	05-C-A HANGAR DOOR	8.49	18,678
53	05-C-C, 05-DE-A, 05-DE-B, 05-C-B	17.05	37,510
54	05-DE-D, 05-DE-E, 05-FG-A, 05-DE-C	16.36	35,992
55	05-FG-C, 05-FG-D, 05-FG-B	12.1	26,972
56	05-FG-E HANGAR DOOR	8.49	18,678
57	FUEL TANK 02-Q-3, 02-Q-1	5.9	12,980 E.W.
58	02-R-3	2.95	6,490

See note on preceding page

Sheet 15 of 19
2064-00
9-1-82 PJP

FUEL FARM MCS: C3.15'

01 LEVEL MCS: 00.41'
04 LEVEL MCS: 70.70'
03 LEVEL MCS: 71.65'
02 LEVEL MCS: 65.15'
01 LEVEL MCS: 55.5'

01 LEVEL

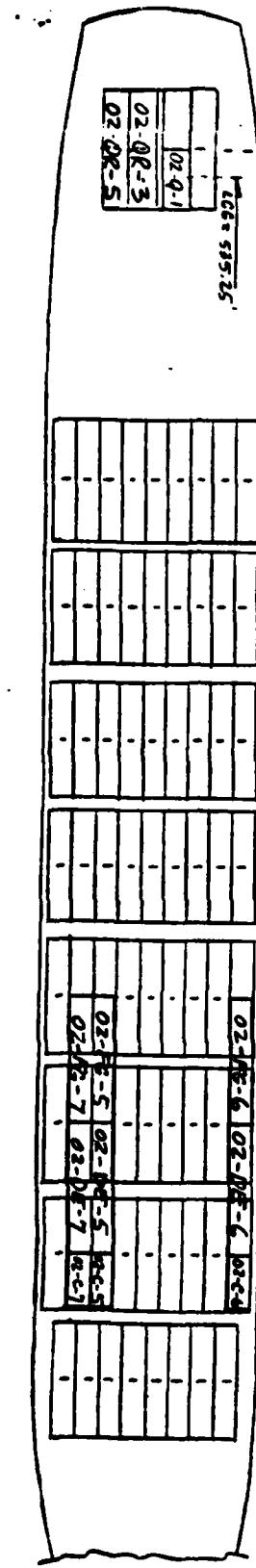
01-0P-6	01-MN-6	01-H-6	01-EE-6	01-00-6
01-0P-4	01-MN-4	01-H-4	01-EE-4	01-CD-4
01-0P-2	01-MN-2	01-H-2	01-EE-2	01-CD-2
01-0P-0	01-MN-0	01-H-0	01-EE-0	01-CD-0
01-0P-1	01-MN-1	01-H-1	01-EE-1	01-CD-1
01-0P-3	01-MN-3	01-H-3	01-EE-3	01-CD-3
01-0P-5	01-MN-5	01-H-5	01-EE-5	01-CD-5
01-0P-7	01-MN-7	01-H-7	01-EE-7	01-CD-7

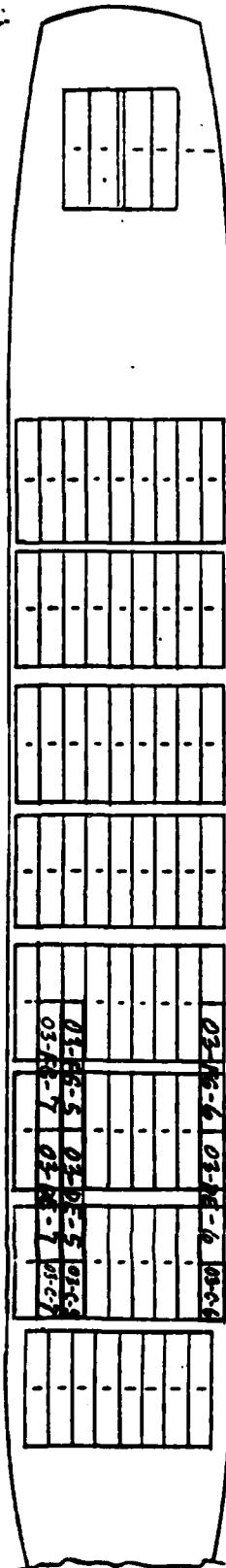
Sheet 16 of 19
2064-00
9-1-82 PJP

FUEL FARM VCG: 63.15'

05 LEVEL VCG = 80.41'
04 LEVEL VCG = 70.78'
03 LEVEL VCG = 73.65'
02 LEVEL VCG = 65.15'
01 LEVEL VCG = 58.9'

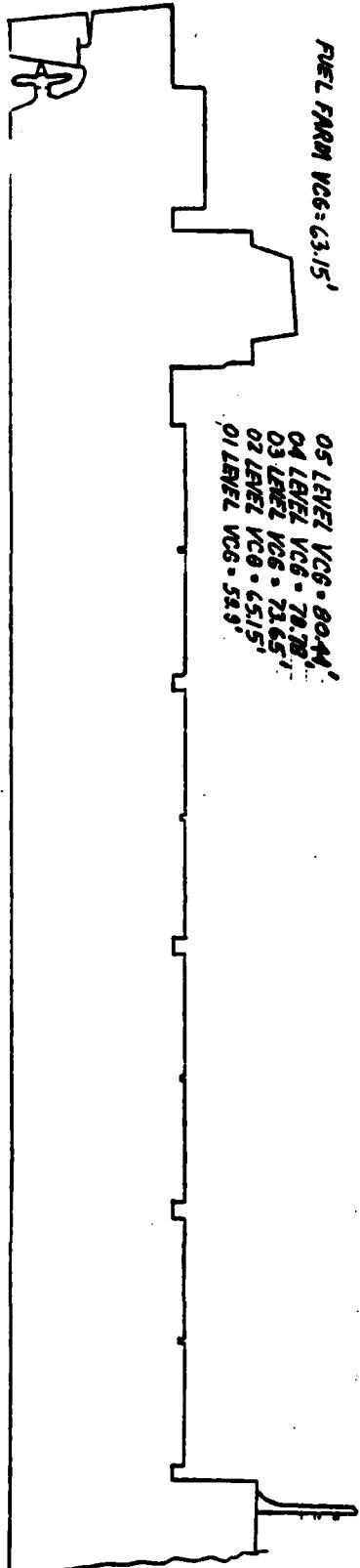
02 LEVEL





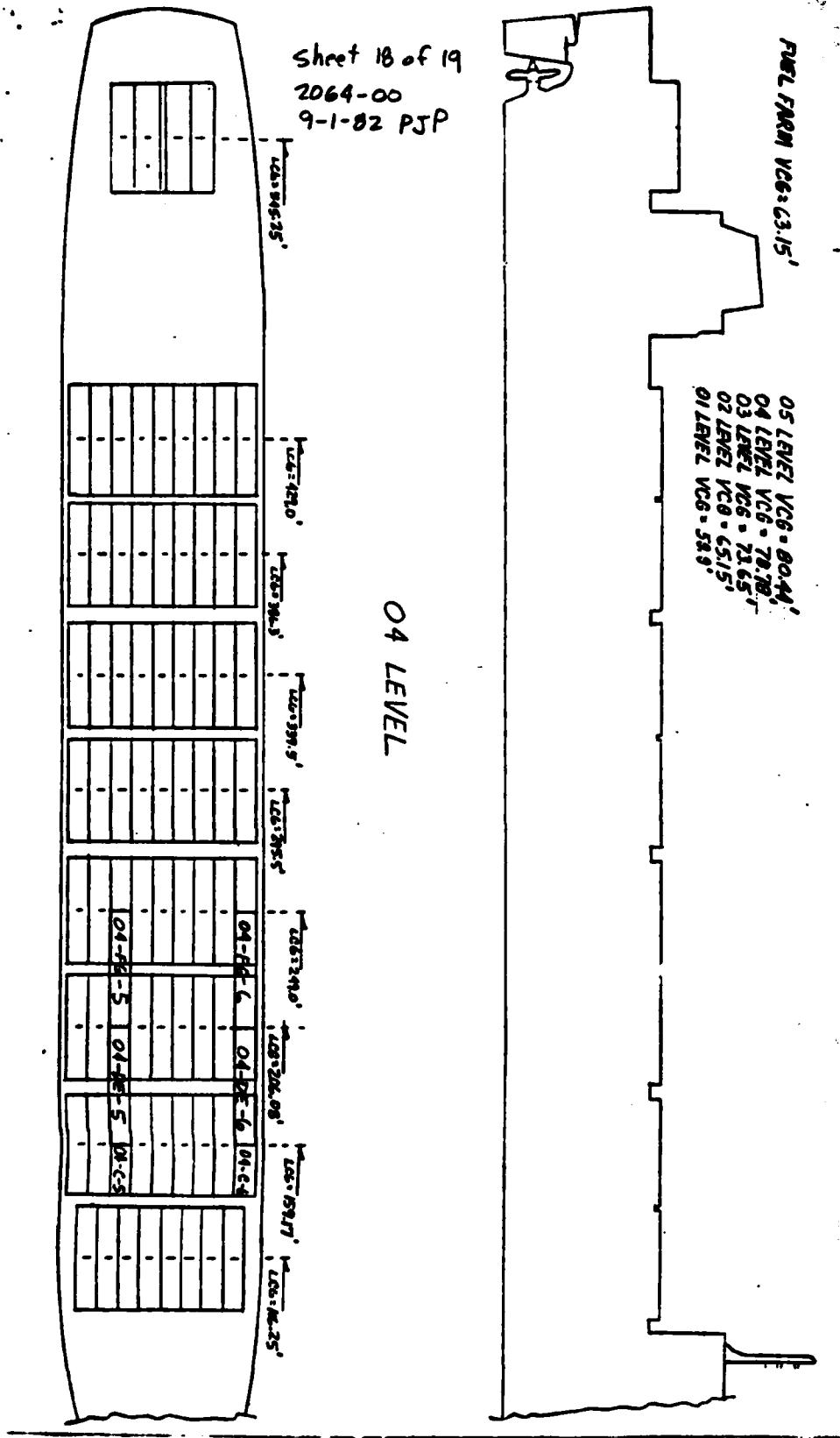
Sheet 17 of 19
2064-00
9-1-82 PJP

03 LEVEL



FUEL FARM VCG: 63.15'
05 LEVEL VCG: 80.41'
04 LEVEL VCG: 78.75'
03 LEVEL VCG: 71.65'
02 LEVEL VCG: 65.15'
01 LEVEL VCG: 52.9'

Sheet 18 of 19
2064-00
9-1-82 PJP



Sheet 19 of 19
2064-00
9-1-82 PJP

FUEL FARM VCB: 63.15'

05 LEVEL VCG = 8041'
 04 LEVEL VCG = 7878'
 03 LEVEL VCG = 7365'
 02 LEVEL VCG = 6515'
 01 LEVEL VCG = 5339'

05 LEVEL

